

ART. V.—*Further Notes on the River Yarra Improvement Sections, at the Botanical Gardens, Melbourne.*

By A. E. KITSON, F.G.S.

[Read 12th June, 1902.]

A former paper<sup>1</sup> on the Geology of this locality was read before this Society on 13th December, 1900. It was stated therein<sup>2</sup> that, at the eastern end of the new cutting on the northern side of the river, a stratum of "black fissile clay, with three thin laminae of comminuted shells, and lenticles of pure sand, 3 feet to 4 feet 6 inches" in thickness, overlay basalt, being separated from it by a bed of sandy clay. It was, also, mentioned that a small parcel of the shelly material, collected from this clay bed, had been mislaid. This collection has, fortunately, come to hand again, and careful examination of the material has enabled a few of the shells to be identified. I am indebted to Mr. J. H. Gatliff, and Mr. J. Dennant, F.G.S., F.C.S., for kindly determining them. The shells were so decomposed that even with the greatest care only a few specimens could be obtained in good order. These prove to be chiefly of lamellibranchs.

The list of those obtained is as follows :—

*Nassa labecula*, A. Adams.

*Tatea rufilabris*, A. Adams.

*Sphaerium* (= *Cyclas*) McGillivrayi, E. A. Smith.

*Corbicula* sp.

*Macra* sp.

The greater number of the fragments consist apparently of those of *Corbicula*. Of the two gastropods, one entire specimen, and several fragments of *Nassa* were found; while the small *Tatea rufilabris* occurred rather sparingly.

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<sup>1</sup> Kitson, A. E.: Geological Notes on the River Yarra Improvement Sections at the Botanical Gardens and Vicinity, Melbourne—Proc. Roy. Soc. Victoria, vol. xiii., n.s., pt. ii., 1900.

<sup>2</sup> *Loc. cit.* p. 247.

By reference to the list of shells given in the former paper as occurring in the shelly marl it will be noticed that neither *Corbicula* nor *Tatea* was included. These shells did not occur in the marl as far as observed. The black clay they were found in was then regarded as being probably the littoral portion of the estuarine deposits, and that opinion has now been confirmed as far as relates to this locality. The occurrence in this clay of *Tatea* and *Corbicula*, and their association with *Nassa* and *Mastra* prove that this spot was near the margin of the mouth of the old Yarra, in water greatly affected by the rise and fall of the tide.

Since the former paper was published, work of an intermittent character has been done in these Yarra Improvements. The cuttings have been carried about 165 yards past Punt Road foot-bridge, and deepened on the western side. The strata on the western side revealed up to the present time consist of 15 feet of alluvium, the lower portion being a yellowish-grey loamy clay with pieces of carbonised wood, overlying 6 feet of dark bluish-grey stiff clay with pieces of wood. No shells of any kind are observable.

[On the east of the bridge the cutting ends in grey indurated claystones and massive beds of grey mudstones. On the northern side these Silurian rocks are covered by 4 feet of alluvium at the eastern end, but at 50 yards west they disappear beneath about 20 feet of alluvium. On the southern side they show at the surface for 75 yards from the end. The beds dip  $80^{\circ}$  at  $47^{\circ}$ . The overlying beds consist of grey and brown loam, 12-16 feet, resting on 8 feet of dark and light coloured loam and clay, the lower portion of which contains a large number of angular fragments of the Silurian rocks. An interesting dyke occurs in the Silurian strata in the southern bank. It is from 16 inches to 2 feet wide, bears  $N.65^{\circ}W.$ , and runs parallel with the section. At the western end it shows at the surface, while at the eastern it is split into two prongs, one 3 inches, the other 8 inches thick. In the face here numerous thin bands and threads branch off and intersect the strata along the joint planes. About 20 feet west of this point a prong runs N. from the dyke. The rock is greatly decomposed, but is evidently of a granitic nature, and, as seen, consists of clay and large crystals of biotite up to 1 inch in

breadth, and  $\frac{1}{20}$  inch in thickness. No quartz was noticed in the material examined. This dyke is probably identical with that from which the micaceous material in the Anderson Street cutting was obtained, and belongs to the same series of intrusions as the smaller dyke near the old pumping station mentioned in the previous paper, and those revealed<sup>1</sup> by the sewerage works in South Yarra.—7.vi.02].

The evidence furnished by the shell-bearing dark clay by its occurrence above the basalt, settles the question of the relative positions of the volcanic and younger sedimentary rocks here. From the evidence of the deposits of sandy clays, sands and gravels, beneath the basalt in the Richmond and Clifton Hill quarries the basalt in those places has not flowed immediately over the marine marls, and it is very doubtful if this arm of the estuary ever extended up the valley to the latter place.

[Dr. Coates records<sup>2</sup> the occurrence of marine shells Foraminifera and Diatomaceae from “the mud of a swamp near the Yarra, where the Melbourne and suburban railway crosses that river.” He says, that in some of the specimens of the deposit “marine shells, pieces of cuttle fish bone, and the debris of echini” occur. Also, that “from inquiries that have been instituted, it is estimated that the swamp has a depth of not less than 60 feet.” He was, therefore, of the opinion that the waters of Port Phillip, at a time probably not very remote, covered this locality, and that after elevation of the land took place a lagoon or saltwater marsh was formed, and with further elevation a possible incoming of fresh water destroyed the organisms.

Accepting this record of marine fossils at South Yarra, the extension of the estuary deposits considerably further up the valley of the Yarra than Anderson Street bridge is clearly proved. The question, therefore, of the relation of the basalt to the shelly marls becomes a still more interesting one. It seems quite improbable for the latter to overlies the basalt, and the only alternatives are either that the basalt is of younger or of

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<sup>1</sup> T. S. Hall, M.A., and G. B. Pritchard: A Contribution to our Knowledge of the Tertiaries in the Neighbourhood of Melbourne—Footnote p. 226, Proc. Roy. Soc. Victoria, vol. ix., n.s., 1896.

<sup>2</sup> John Coates, M.R.C.S.L.: On a Deposit of Diatomaceae at South Yarra—Trans. Roy. Soc. Victoria, vol. v., 1860.

contemporaneous age. I am inclined to adopt the latter opinion, and to think that the basalt has flowed north-westward into the deep estuary, and filled it up almost completely except on the southern edge. It was probably prevented from occupying the indentations of the Botanical Gardens lagoon and South Yarra valley by the jutting points of Silurian rocks which occur at the eastern sides of their outlets, as may be seen by reference to the map with the former paper. These points have doubtless deflected the flow towards the north. The outlet to Port Phillip was probably not closed for some time later, and in the meantime brackish water fauna occupied the locality near the Anderson Street bridge, as shown by the shells specially mentioned herein.—7.vi.02].

Narrow arms of the estuary, similar to this of the Yarra, formerly existed along the Moonee Ponds Creek and the Saltwater River. In the former locality marine shells have been found,<sup>1</sup> and the estuarine deposits probably extended up to the vicinity of Flemington Road Railway Station. On the Saltwater River in all probability they reached the foot of and even beyond the semi-circular ridge in the Flemington Racecourse, occupying the whole of the "Flat" in this reserve.

At the Botanical Gardens the old estuary appears to have had fairly steep banks. For most of the way from its eastern side, and round its northern end past Kensington and to Footscray, the margin of the estuary consisted of more or less steep banks and cliffs, while on going to the south-west towards Williamstown these cliffs vanish, and the shore is low, and slopes gently inland.

In close proximity to the place where the marine shells occur, along the Moonee Ponds Creek, a portion of the jaw of *Diprotodon australis*, Owen, has been found, as recorded<sup>2</sup> by Mr. Pritchard, and though the nature of the deposits containing the shells, and their relation to the sandy clay in which the bone was found are not stated, yet it appears as if they are contemporaneous deposits. Mr. Pritchard has evidently so regarded them, and is of opinion that they are of Pleistocene age.

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<sup>1</sup> Pritchard, G. B.: On the Occurrence of *Diprotodon australis*, Owen, near Melbourne—*Proc. Roy. Soc. Victoria*, vol. xii., u.s., pt. i., 1899.

<sup>2</sup> *Loc. cit.*

In a recent paper<sup>1</sup> by Mr. J. F. Mulder, the basalt of the plains of the Moorabool River, near the viaduct on the Geelong-Ballarat Railway, is shown to be resting upon a deposit of sandy gravel, full of calcareous casts of Newer Pliocene fossil shells, thus proving the basalt to be not older than Newer Pliocene age. The upper volcanic rocks of the whole of the Western Plains coming eastwards to the Melbourne district are regarded as belonging to the one age. Therefore, the basalt in the Lower Yarra Valley must be Newer Pliocene or younger.

Evidence is present showing that the whole of the area bounding the Yarra Estuary was within late geological time beneath the waters of the Bay, and has since been slowly raised. Meanwhile the Yarra continued cutting its channel deeper, and extending its mouth till at the present time this is about 5 miles away in a straight line from its former mouth at the Botanical Gardens.

The occurrence of indentations in the eastern shores of Port Phillip, such as the areas occupied by the Elwood and Carrum Swamps, and the thin deposits containing recent shells which cover a large extent of the coast along the western shores of Port Phillip from Williamstown towards Geelong, also prove that the area bordering the northern part of Port Phillip is one of comparatively recent elevation.

Again, along the margin of Western Port, and in the valley of the Powlett River in South Gippsland, there also occurs what seems undoubted evidence of the existence of a large sheet of water in comparatively recent times, and of subsequent elevation of the land surface. In the Powlett Valley the country in some parts has the appearance of an area originally consisting of low mud banks, islands and promontories, separated by indentations with fairly deep channels having the character of those now visible in Western Port. [Further east, also, such as along the northern shores of Corner Inlet, evidence of elevation does not seem to be wanting. It seems, therefore, as if a considerable portion of the southern coast of Victoria has undergone some elevation during recent times. I am indebted to Messrs. T. S. Hall, M.A.,

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<sup>1</sup> J. F. Mulder: Newer Pliocene Strata on the Moorabool River—Proc. Roy. Soc. Victoria, vol. xiv., part ii., 1901.

J. Barnard, and F. G. A. Barnard for information respecting the diatomaceous deposit. I was not familiar with the paper by Dr. Coates till considerably after this paper was read. I desire to thank Professor Gregory, D.Sc., F.R.S., for considerably allowing the new material referred to herein to be microscopically examined in the Geological Laboratory at the University, and also Mr. H. J. Grayson for kindly making the examination. Mr. Grayson has determined the occurrence of diatoms belonging to the genera *Campylodiscus*, *Actinocyclus*, *Surirella*, *Navicula*, and *Inelosira* in the material from the most easterly cutting, and also a few spicules of a sponge belonging to the genus *Spongilla*. In one of the beds here half of the material consists of diatoms, almost exclusively *Actinocyclus* with a few *Campylodiscus*. The shell-bearing clay above the basalt contains no diatoms except an occasional frustule of *Campylodiscus*. Mr. Grayson had himself collected some diatomaceous earth at a depth of 5 feet from the surface, close to the spot from which the collection examined by Dr. Coates was made. He found that the prevailing diatoms were those belonging to the first four mentioned genera, and that the material differs in no way from the Punt Road samples. He also says that diatoms are abundant at Coode Island and West Melbourne lagoon at a depth of about 5 feet, near the Corporation Freezing Works in Flinders Street, Melbourne, and in sewerage works on the southern side of the Yarra River on the Port Melbourne flat. It will thus be seen that they occur over a large area of the low land in the metropolis.—7.vi.02].

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